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Peristaltic pump provided with means to contain and guide the flexible suction and delivery pipe within its seat.

Abstract:

The invention concerns a peristaltic pump comprising a flexible pipe (4), positioned along a U path of a semicylindrical seat (2A) formed in the pump body, and a rotor (3) rotating inside the loop formed by the pipe (4), about an axis coinciding with the axis of said seat, and carrying at the periphery pressure rollers (8) apt to press the flexible pipe (4) against the seat (2A). According to the invention, the sidewalls defining said semicylindrical seat are provided with half-annular projections (5, 6) to contain and guide the flexible pipe (4), said half-annular projections (5, 6) being concentric to and having a smaller diameter than said seat (2A).

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(54) Peristaltic pump provided with means to contain and guide the flexible suction and delivery pipe within its seat.

(57) The invention concerns a peristaltic pump comprising a flexible pipe (4), positioned along a U path of a semicylindrical seat (2A) formed in the pump body, and a rotor (3) rotating inside the loop formed by the pipe (4), about an axis coinciding with the axis of said seat, and carrying at the periphery pressure rollers (8) apt to press the flexible pipe (4) against the seat (2A). According to the invention, the sidewalls defining said semicylindrical seat are provided with half-annular projections (5, 6) to contain and guide the flexible pipe (4), said half-annular projections (5, 6) being concentric to and having a smaller diameter than said seat (2A).

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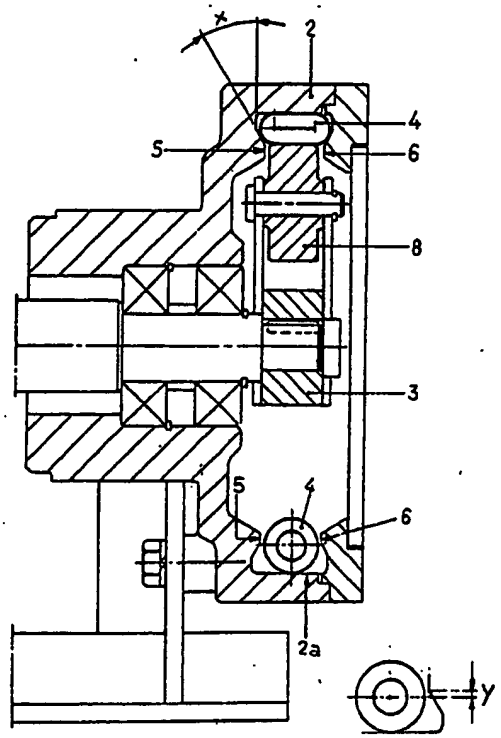

FIG. 2

FIG. 2A

PERISTALTIC PUMP PROVIDED WITH MEANS TO CONTAIN AND GUIDE THE FLEXIBLE SUCTION AND DELIVERY PIPE WITHIN ITS SEAT

The object of the present invention is a pump of the type commonly defined as peristaltic pump. Pumps of this type are described for example in US-A-2,693,765 and in FR-A-2 262 209. They essentially comprise a flexible pipe - for instance of rubber, eventually reinforced with fabric or harmonic steel - positioned inside the pump along a U path, the saddle of the U being formed by a substantially semicylindrical seat. The flexible pipe is pressed against said seat by pressure rollers carried at the periphery of a rotor, which rotates within the saddle of the U on a shaft coaxial to said semicylindrical seat.

While the periphery of the rotor moves spaced apart from the inner surface of the loop formed by the U positioned pipe, the pressure rollers bear onto said surface to an extent such as to squash the pipe against the respective seat to the point that the inner space of the pipe closes up completely. The direction of rotation of the rotor is such that the pipe zone which closes up under the pressure of the roller moves from the suction end towards the delivery end of the pipe itself, thereby allowing the liquid to flow through the pipe.

In the use of known peristaltic pumps, especially those of larger capacity, a serious drawback has however since long been found, due to wear of the flexible pipe determined by the repeated squashings and releases to which it is subjected by the pressure rollers.

In fact, in the first period of use of the pump, the flexible pipe keeps its elastic properties unaltered and reacts in a perfectly balanced manner to the squashing action of the pressure roller, taking up a perfectly symmetrical configuration between the flat sidewalls defining the semicylindrical seat into which it is housed. Nevertheless, after a certain period of use of the pump, the flexible pipe gradually wears out, looses its initial characteristics of stiffness and, under the squashing action of the pressure roller, it reacts in a non-balanced manner and is inclined to slip sideways into the gaps existing between the sidewalls of the semicylindrical seat and the pressure roller itself.

Said behaviour of the pipe is particularly harmful because, as well as notably accelerating the wear of the pipe itself, it simultaneously reduces the efficiency of the pump, due to the fact that the inner space of the pipe does not close up completely as the pressure roller rolls onto the same. In practice, therefore, in order to keep the peristaltic pump in normal working conditions, the flexible pipe has to be replaced after a fairly short period of use and, in any case, when its sealing properties would still allow a protracted use thereof.

The object of the present invention is therefore to obtain a peristaltic pump in which there is no longer the risk that the flexible pipe may move out of the respective seat or may anyhow perform movements apt to alter its symmetrical configuration under the squashing action of the pressure roller.

According to the present invention, said object is reached by providing the sidewalls defining the semicylindrical seat housing the flexible pipe with half-annular projections, concentric to and having a smaller diameter than said seat, so as to form a continuous rim to contain and guide the flexible pipe both when it is free and when it is squashed by the pressure rollers.

Further characteristics and advantages of the peristaltic pump according to the present invention will anyhow be more evident from the following description of a preferred embodiment thereof, illustrated by way of example on the accompanying drawings, in which:

Fig. 1 is a front view of the peristaltic pump according to the present invention, from which the cover has been removed to show the rotor unit;

Fig. 2 is a section view, along the line II-II of fig. 1, a pressure roller having been removed for further clearness;

Fig. 2a shows a detail of fig. 2, on an enlarged scale, illustrating more clearly the flexible pipe and the respective seat;

Fig. 3 is a view similar to fig. 1, illustrating in further detail the pump body, with the half-annular projections provided on the same; and

Fig. 4 shows a detail of fig. 3, illustrating half-annular projections formed in one piece with the pump body.

As shown in fig. 1, the peristaltic pump according to the present invention comprises a base 1, to which there is fixedly connected a cylindrical casing 2 into which rotates a rotor 3, the rotor shaft being coaxial to the cylindrical casing 2. A semicylindrical seat 2a is moreover formed into the inner part of the casing 2, onto which seat bears the flexible pipe 4.

The pipe 4 is positioned along a U path, the saddle of the U being formed by said semicylindrical seat 2a; the end parts, forming the branches of the U, extend instead outwardly of the casing 2, into A and M, so as to be respectively connected to the suction and delivery pipes.

The pressure rollers 7 and 8 are mounted idle on the respective pins in diametrally opposite posi-

tions of the rotor 3. According to the known technique of construction of this type of peristaltic pumps, the periphery of the pressure rollers 7, 8, projects outwardly of the rotor 3, so as to forcefully compress the flexible pipe 4 against the respective seat 2a, in the manner clearly shown in fig. 1 and in the top part of figs. 2 and 3.

Since the rotor 3 rotates about its central shaft in the direction of rotation indicated by the arrow F in fig. 1, the rollers 7 and 8 roll onto the surface of the pipe 4 squashing successive zones thereof against the seat 2a. The compressive action is very powerful, so that the inner space of the pipe 4 is totally closed up, as clearly shown in the top part of fig. 2 and in fig. 3. In this way, as the roller 7 or 8 moves forward squashing the pipe, the liquid downstream of the roller - in respect of the direction of advancement of the rotor 3 - is driven out of the delivery pipe M. At the same time, the vacuum produced in the pipe as it springs back into the non-squashed configuration, draws other liquid through the suction pipe A.

Thanks to the opposed positioning of the two pressure rollers 7 and 8, at the moment in which the pressure roller 7 is about to abandon the pipe 4, in correspondence of the end zone of the seat 2a, the roller 8 is already pressing the pipe in the starting zone of said seat 2a, whereby there is a continuous flow of liquid through the pipe 4, with no possibility of undesirable backflows.

As said in the introductory part, the Applicant has however been able to ascertain that - especially in the case of pumps using pipes 4 of larger dimensions - the pipe itself, after a fairly short period of use, looses its stiffness, springs out of shape under the compressive action of the rollers 7 and 8, and tends to leave the seat 2a slipping into the gap between the pressure rollers and the sidewalls of the seat 2a.

The present invention therefore proposes to provide on both sidewalls of the seat 2a a pair of opposed half-annular projections 5 and 6, concentric to the semicylindrical seat 2a and having a smaller diameter than the same. The projections 5, 6, have a transversal dimension sufficient to reduce to a very modest value the gap between them and the pressure rollers 7, 8; furthermore, thanks to their particular configuration, they form elements to contain and guide the pipe 4 in rest conditions, during the initial squashing step, and during the final total compression.

As shown in fig. 3, the projections 5, 6, preferably have a trapezoidal cross section, with an oblique side 5a, 6a, facing the semicylindrical seat 2a. The inclination angle - indicated in fig. 2 by reference X - of the oblique sides 5a, 6a, in respect of a plane perpendicular to the axis of the rotor 3, is preferably included between 20° and 45°, while the diameter of the half-annular projections 5 and 6 is such that the distance between their edges 5b, 6b, and the semicylindrical seat 2a is greater than the radius of the pipe 4 by an extent included between 0.5 and 12 mm.

In this way the pipe 4, in each of the aforespecified steps, practically always remains in contact with the projections 5, 6, and is hence guided by them, during compression, so as to always keep in a perfectly centred and symmetrical position under the pressure roller. The inclination of the sides 5a, 6a, is in fact calculated so as to follow the gradual increase of the transversal dimensions of the pipe 4, as this latter gets squashed closer to the semicylindrical seat 2a.

Thus, the presence of the projections 5, 6, most reliably prevents any shifting of the flexible pipe 4 out of its original position defined during planning, even after a prolonged use of the pump, that is when the pipe 4, though still being fit from the point of view of sealing, no longer possesses the initial characteristics of stiffness which were indispensable for a proper working in the known type peristaltic pumps. In fact, in the pump of the present invention, the flexible pipe can still be used for a long time without providing any drawbacks at all, with a considerable economic advantage compared to the previously known pumps.

The half-annular projections 5 and 6 can be formed by any known technique, according to the dimensions and characteristics of the pump and to the nature of the flexible pipe 4. Thus, for example, the projections 5, 6, can be provided on a conventional pump body, to which they are fixed by known fixing means as screws, adhesives, fitting in systems, and the like, as illustrated in fig. 3. Or else, the projections may be formed in one piece with the pump body, both in the event that the latter is directly obtained by casting, or in the event that it is obtained or trimmed by machining, as illustrated in fig. 4.

The material forming the projections 5, 6, has to be carefully selected, so as not to result abrasive in respect of the pipe 4. For this purpose, use can be made of plastic, ceramic or metallic materials, or of suitably combined mixed materials, so as to simultaneously reach the two desired objects of proper mechanical resistance and of no wear of the pipe 4. In the event of using metallic materials, the sides 5a and 6a contacting the pipe 4 will be preferably subjected to a particularly accurate surface finishing treatment.

From the previous description, it appears evident that the present invention has fully reached its intended object. In fact, the described peristaltic pump most reliably prevents any shifting of the flexible pipe out of the respective seat during the compressive action of the pressure rollers, thereby

guaranteeing a life of the pipe itself which is far longer than that of known type pumps.

The invention has been described with reference to a specific embodiment thereof, but it is evident that the protection granted to the same extends to any other embodiments apt to be equally useful and to realize the same idea of solution described above, even with different constructions. In particular, one should not consider as limitative the shape of the section of the projections 5, 6, which can be varied according to the characteristics of the pipe and to the geometry of the pump, so as to obtain in the best manner the results proposed by the present invention.

Claims

1) Peristaltic pump comprising a flexible pipe, positioned along a U path of a semicylindrical seat formed in the pump body, and a rotor rotating inside the loop formed by the pipe, about an axis coinciding with the axis of said seat, and carrying at the periphery pressure rollers apt to press the flexible pipe against the seat, characterized in that the sidewalls defining said semicylindrical seat are provided with half-annular projections to contain and guide the flexible pipe, said half-annular projections being concentric to and having a smaller diameter than said seat.

2) Peristaltic pump as in claim 1), wherein said projections have a trapezoidal cross section, with the major base in contact with said sidewalls and with an oblique side facing the semicylindrical seat.

3) Peristaltic pump as in claim 2), wherein the edge of said oblique side, which is not in contact with said sidewalls, is spaced from the semicylindrical seat by 0.5 to 12 mm more than the radius of the flexible pipe.

4) Peristaltic pump as in claim 2), wherein the angle of inclination of the oblique side of said half-annular projections, in respect of a plane perpendicular to the axis of the pump rotor, is of between 20° and 45°.

5) Peristaltic pump as in claim 1), wherein said projections are formed in one piece with the pump body.

6) Peristaltic pump as in claim 1), wherein said projections are fixed on the pump body by suitable means.

7) Peristaltic pump as in claim 5), wherein said projections are made of plastic or ceramic material.

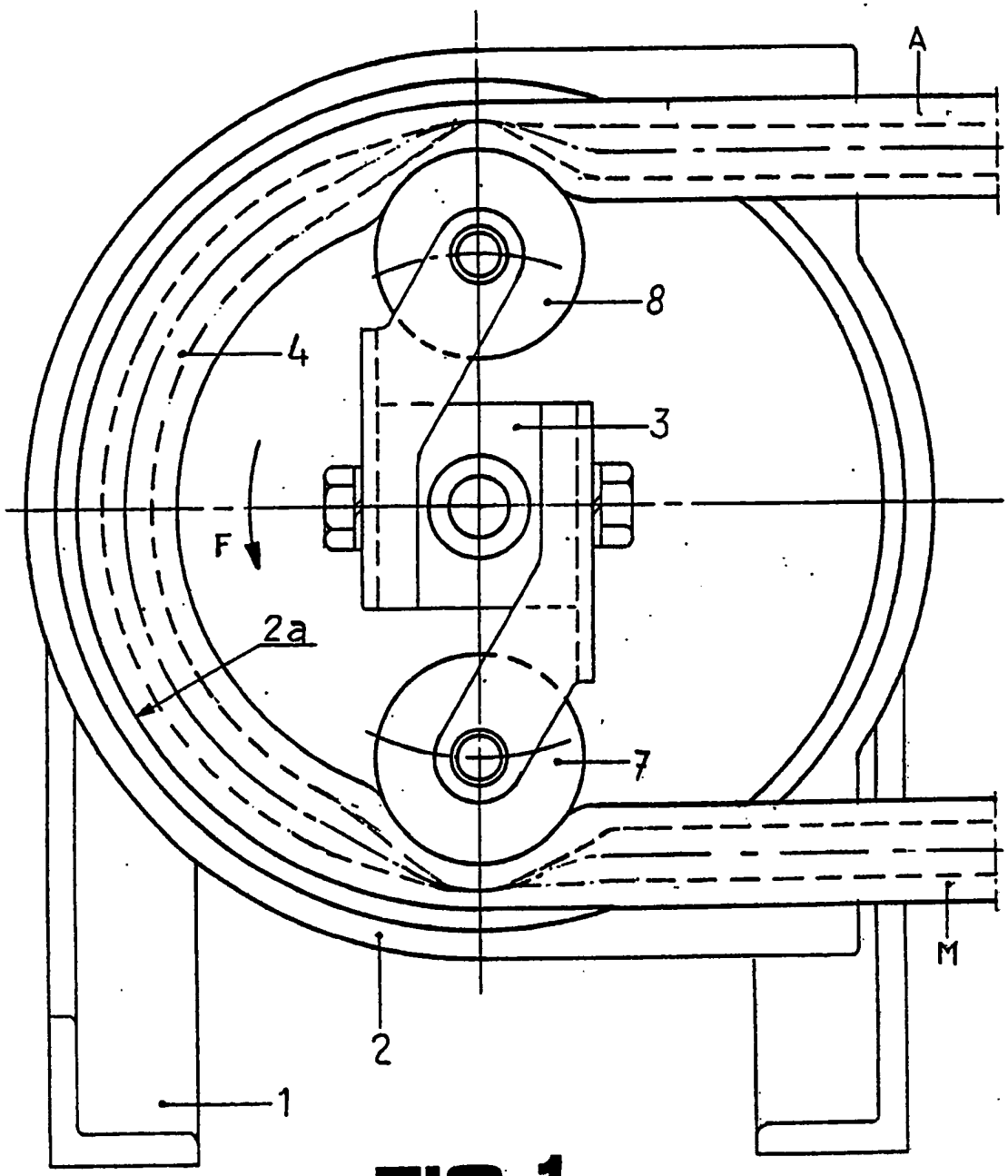

FIG. 1

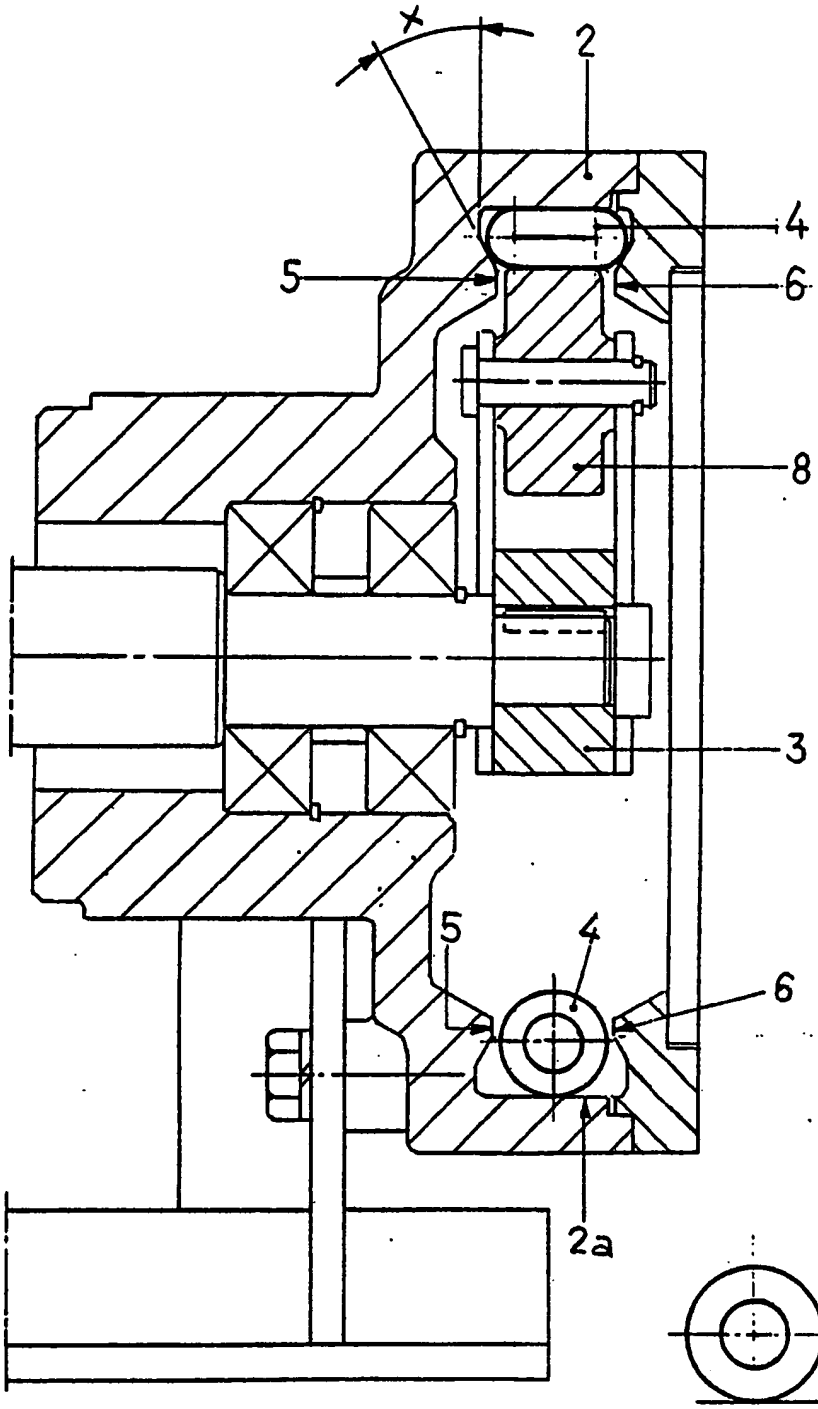

FIG. 2

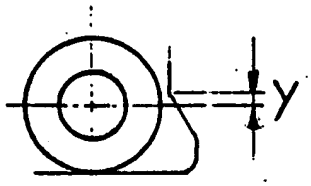

FIG. 2A

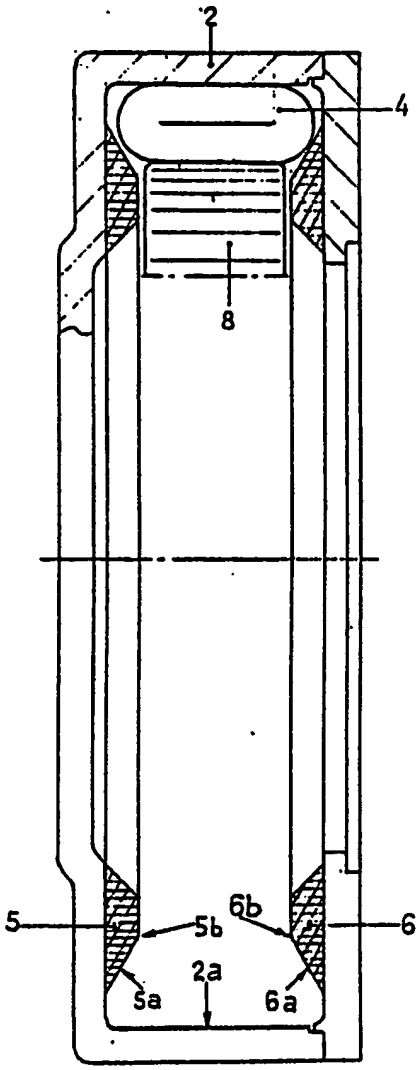

FIG.3

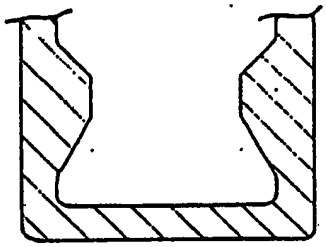

FIG.4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 10 9535

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
A,D	US-A-2 693 765 (PETRI) * Column 2, lines 15-42; figures 1,5,6 * ---	1	F 04 B 43/12
A,D	FR-A-2 262 209 (LAUTERJUNG et al.) * Page 11, line 35 - page 12, line 12; figures 7,9 * -----	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			F 04 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19-07-1989	VON ARX H.P.

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